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Analysis of Accidents Related to Falls of Ground in Metal and Nonmetal Mines, 1972-73

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Analysis of Accidents Related to Falls of Ground in Metal and Nonmetal Mines, 1972-73

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United States Department of the Interior
mesa
Mining Enforcement and Safety Administration

UNITED STATES DEPARTMENT OF THE INTERIOR
Rogers C. B. Morton, Secretary

Mining Enforcement and Safety Administration
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ANALYSIS OF ACCIDENTS RELATED TO FALLS OF GROUND IN METAL AND NONMETAL MINES, 1972-73

by

E. D. Seals[1] and R. A. Speirer[2]

ABSTRACT

Accidents resulting from falls of ground are among the four most frequent causes of injuries in metal and nonmetal mining. During 1972-73 a total of 33 fatal and 673 disabling injuries resulted from falls of ground at underground metal and nonmetal mines. Lead-zinc mines had the highest percentage of fatalities (33 percent), followed by copper mines (21 percent), and gold-silver mines (21 percent). Copper mines had the highest percentage of disabling injuries (38 percent), followed by lead-zinc mines (20 percent), and gold-silver mines (17 percent). The most frequent cause of accidents resulting from falls of ground is the failure to detect and bar down loose rock. Other primary causes are the use of improper scaling equipment, the failure to install adequate ground support, and the failure to bar down detected loose rock. Approximately 67 percent of the fatal injuries and 87 percent of the disabling injuries occurred to victims who, apparently, were totally unaware that they were under loose ground. The accident data indicates the need for increased emphasis on training stope and face miners to (1) recognize localized rock conditions that tend to produce hazardous ground, (2) use the proper scaling tools and techniques, (3) test the backs, faces, and ribs adequately and repeatedly, and (4) employ more effective ground support at the working faces.

INTRODUCTION

This report was prepared to provide a preliminary analysis of the fatal and disabling injuries that were related to falls of ground at metal and nonmetal underground mines during 1972-73. The study is based upon accident data and information gathered by the Health and Safety Analysis Center from reports prepared by Federal mine inspectors and mining company personnel.

Details of fatal accidents are readily available for both 1972 and 1973; however, as a result of changes in the reporting forms for 1973 various details related to the disabling injuries prior to 1973 are not available for this analysis. Considering the many hundreds of disabling injuries which occurred during 1972-73, and the fact that each report must be examined individually to extract all pertinent details, samples of 100 and 200 reports were employed. This technique permits accurate identification of the primary and contributing causes of rock fall injuries within a minimum amount of time. The analysis indicates that injuries resulting from falls of ground continues to be a critical accident area in metal and nonmetal mining.

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ANALYSIS

The following tables analyze nine factors that are related directly or indirectly to fatal and disabling fall of ground injuries that occurred in underground metal and nonmetal mines during 1972-73. All fatal injuries for the period were included in the study. Samples in groups of 100 and 200 were utilized to analyze the total of 673 disabling injuries that are on record for 1972-73.

Table 1 indicates that the greatest cause of both fatal and disabling falls of ground injuries is the failure to detect and bar down loose rock. Accident and injury reports indicate that approximately 67 percent of the fatal injuries and 87 percent of the disabling injuries occurred to victims who were unaware that they were under loose ground. A lack of effective ground support, inadequate training, and carelessness all contribute to the high percentages of fatal and disabling injuries in this category.

TABLE 1. - Fall of ground injuries by cause

Cause	From total of 33		From sample of 200	
	1972-73 fatals	Percent	1972-73 disabling	Percent
Failure to detect and bar down loose rock	22	67	174	87.0
Use of improper scaling equipment	4	12	3	1.5
Failure to provide adequate ground support	4	12	19	9.5
Failure to bar down detected loose rock.	2	6	4	2.0
Not determined	1	3	-	-
	33	100	200	100.0

Table 2 indicates that scaling loose rock and drilling resulted in 48 percent of the fatal injuries and 56 percent of the disabling injuries. Scaling loose rock resulted in the highest percentage of fatal accidents (30 percent), and drilling resulted in the highest percentage of disabling injuries (39 percent). The high percentage of scaling injuries is attributed primarily to the use of unsafe techniques and tools; however, drilling injuries often are difficult to prevent except by the use of adequate temporary ground support or equivalent protection at the drill. Ordinary rock sounding techniques sometimes are inadequate to detect loose ground that later is knocked down by drilling vibration. With the exception of the above two activities there appears to be little correlation of percentages between fatal and disabling accidents for the remaining nine activities listed in table 2.

TABLE 2. - Fall of ground injuries by activity

Activity	From total of 33		From sample of 200	
	1972-73 fatals	Percent	1972-73 disabling	Percent
Scaling loose rock	10	30	35	18
Drilling	6	18	77	39
Walking to work area	6	18	14	7
Sitting in work area	3	9	4	2
Moving equipment	2	6	9	4
Loading ore	2	6	12	6
Timbering	1	3	29	14
Cleaning up floor	1	3	3	1
Repairing equipment	1	3	8	4
Wiring electrical ground	1	3	-	-
Loading holes	-	-	9	5
	33	99	200	100

Table 3 indicates that stopes had the greatest proportion of fatal and disabling injuries during the period under evaluation. Stopes, headings, and faces comprise the advance working areas where falls of ground are most likely to occur. Combined, these locations accounted for 66 percent of the fatal injuries and 46 percent of the disabling injuries.

TABLE 3. - Fall of ground injuries by location

Location	From total of 33		From sample of 100	
	1972-73 fatals	Percent	1973 disabling	Percent
Stope	12	36	40	40
Heading	8	24	-	-
Drift	2	6	40	40
Raise	2	6	12	12
Face	2	6	6	6
Intersection	2	6	-	-
Crosscut	2	6	-	-
Entry	1	3	-	-
Bench	1	3	1	1
Haulageway	1	3	-	-
Crusher room	-	-	1	1
	33	99	100	100

Table 4 indicates that on a single year's basis the greatest number of fatal and disabling injuries occurs among workers that are in their first year of job experience. The table presents total injuries, not frequency rates, and is intended to be a guideline for identification of areas where corrective effort possibly will produce the greatest results.

TABLE 4. - Fall of ground injuries by job experience

Job experience, years	1972-73 fatals (33)	Percent	1973 disabling (sample of 100)	Percent
<1	6	18	19	19
1- 2	4	12	4	4
2- 3	4	12	12	12
3- 4	3	9	1	1
4- 5	2	6	7	7
5-10	6	18	20	20
10-15	4	12	18	18
>15	2	6	13	13
Unknown	2	6	6	6
	33	99	100	100

Table 5 indicates that on a single year's basis the greatest number of fatal and disabling injuries occurs within the category of workers that have been at the mine less than 1 year. As in the previous table, total injuries and not frequency rates are presented to show where corrective effort will produce the greatest results.

TABLE 5. - Fall of ground injuries by mine experience

Years at mine	1972-73 fatals (33)	Percent	1973 disabling (sample of 100)	Percent
<1	6	18	34	34
1- 2	4	12	9	9
2- 3	4	12	12	12
3- 4	3	9	2	2
4- 5	1	3	6	6
5-10	6	18	19	19
10-15	3	9	7	7
>15	4	12	11	11
Unknown	2	6	-	-
	33	99	100	100

Tables 6 through 9 need no special explanation or interpretation; however, special note should be given to the fact that in table 9 the lead-zinc mines are recorded as having the most fatalities, and the copper mines as having the most disabling injuries during the periods under consideration. These tables present total injuries, not frequency rates, that identify areas where a concentration of corrective effort can expect to produce the greatest reduction of injuries.

TABLE 6. - Fall of ground injuries by occupation

Occupation	1972-73 fatals (33)	Percent	1973 disabling (sample of 100)	Percent
Miner	18	55	54	54
Driller	5	15	8	8
Miner helper	2	6	19	19
Driller helper	2	6	-	-
Section helper	2	6	5	5
Loader operator	1	3	2	2
Shift boss	1	3	1	1
Equipment operator	1	3	2	2
Scaler	1	3	1	1
Chute tapper	-	-	5	5
Mechanic	-	-	2	2
Timberman	-	-	1	1
	33	100	100	100

TABLE 7. - Fall of ground injuries by age

Age	1972-73 fatals (33)	Percent	1973 disabling (sample of 100)	Percent
18-20	3	9	8	8
21-25	5	15	20	20
26-30	5	15	18	18
31-35	3	9	9	9
36-40	5	15	11	11
41-45	3	9	15	15
46-50	6	18	8	8
51-55	1	3	5	5
56-60	1	3	5	5
Unknown	1	3	1	1
	33	99	100	100

TABLE 8. - Fall of ground injuries by time of day

Time of day	1972-73 fatals (33)	Percent	1973 disabling (sample of 100)	Percent
8 a.m.-noon	8	24	37	37
Noon-4 p.m.	8	24	24	24
4 p.m.-8 p.m.	7	21	20	20
8 p.m.-midnight	1	3	9	9
Midnight-4 a.m.	4	12	3	3
4 a.m.-8 a.m.	5	15	7	7
	33	99	100	100

TABLE 9. - Fall of ground injuries by mine product

Product	1972-73 fatals (33)	Percent	1973 disabling (sample of 100)	Percent
Lead-zinc	11	33	20	20
Gold-silver	7	21	17	17
Copper	7	21	38	38
Limestone	4	12	-	-
Salt	2	6	1	1
Gilsonite	1	3	-	-
Vanadium	1	3	5	5
Molybdenum	-	-	6	6
Iron	-	-	4	4
Gemstone	-	-	2	2
Other	-	-	7	7
	33	99	100	100

CONCLUSIONS

1. Fall of ground accident investigation reports, particularly those involving fatal accidents, invariably recommend that the men be more thoroughly trained in the proper methods of testing for, barring down, and supporting loose ground. The data presented in this report indicate that these recommendations are not always being followed, or that possibly the training is not reaching the personnel most likely to benefit or be influenced.

2. Considering the fact that 67 percent of the fatalities and 87 percent of the disabling injuries occurred to personnel who thought that they were under reasonably safe ground, the need is apparent for greater surveillance of working areas on the part of both labor and management, with a corresponding increase in effective ground support.

3. Forty-eight percent of the fatal accidents and 56 percent of the disabling accidents involve scaling loose rock and drilling, indicating that hazardous conditions are either unrecognized or neglected by the victim, who many times were found to be using unsafe tools and techniques.

4. Stopes and other types of advancing work faces are the critical areas accounting for 66 percent of the fatalities and 46 percent of the disabling injuries.

5. The accident data indicate that on a single year basis, most accidents occur in the following categories of personnel: (a) those engaged in the first year of job experience and (b) those engaged in the first year of employment at the mine regardless of job experience. Improvement in these areas possibly can be accomplished with additional training and closer supervision of personnel.

6. Lead-zinc, gold-silver, and copper mines had the greatest numbers of fatal and disabling injuries reported for 1972-73. Although the data presented do not reflect the accident and injury frequency rates, the aforementioned mines are identified as those where a concentration of corrective effort will produce the greatest reduction in total numbers of fatal and disabling injuries.

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